FOREST PEST LEAFLET 135

Hemlock Dwarf Mistletoe

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The hemlock dwarf mistletoe, *Arceuthobium tsugense* (Rosendahl) G. N. Jones, (fig. 1), extensively damages hemlock forests in west coastal North America (fig. 2). This parasitic, seed-bearing plant is prevalent in hemlock forests of southeastern Alaska and coastal British Columbia. It ranges inland from the coast in Washington and Oregon to the crest of the Cascade Range. In California. *A. tsugense* occurs in the Sierra Nevada Mountains as far south as Alpine County and along the coast to Mendocino County. Throughout its range, *A. tsugense* occurs in patchlike patterns in the forests. Some forests are severely infested (fig. 3); some sparsely, and some not at all. The incidence and severity of the parasite are influenced greatly by stand structure and developmental history of the forest.

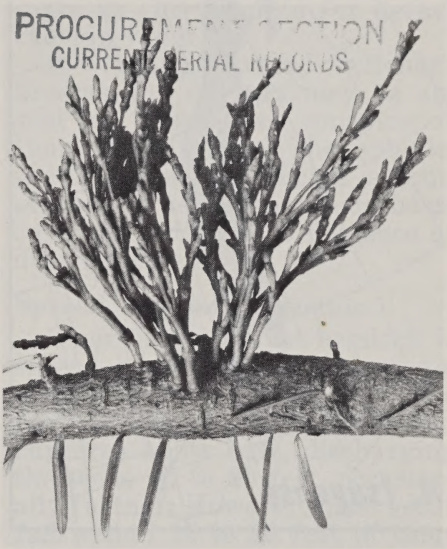

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Figure 1.—Dwarf mistletoe infection on western hemlock illustrating the segmented aerial shoots.

Hosts

The principal hosts of hemlock dwarf mistletoe are western hemlock and mountain hemlock. When the true firs—alpine, Pacific silver, grand, and noble—and the pines—lodgepole, whitebark, or western white—grow in association with either primary host, they may also become infected. In rare instances, this dwarf mistletoe is found on Sitka. Engelmann, and Brewer spruces. It is not known to parasitize Douglas-fir, a common associated species.

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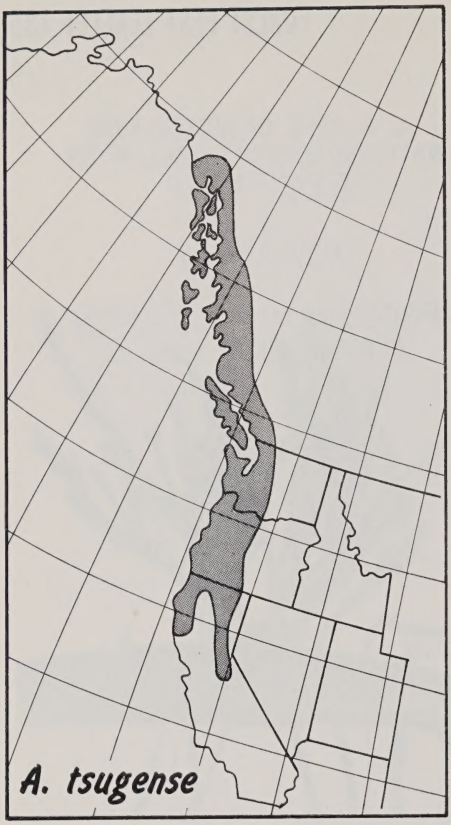

Figure 2.—Distribution of hemlock dwarf mistletoe in western North America.

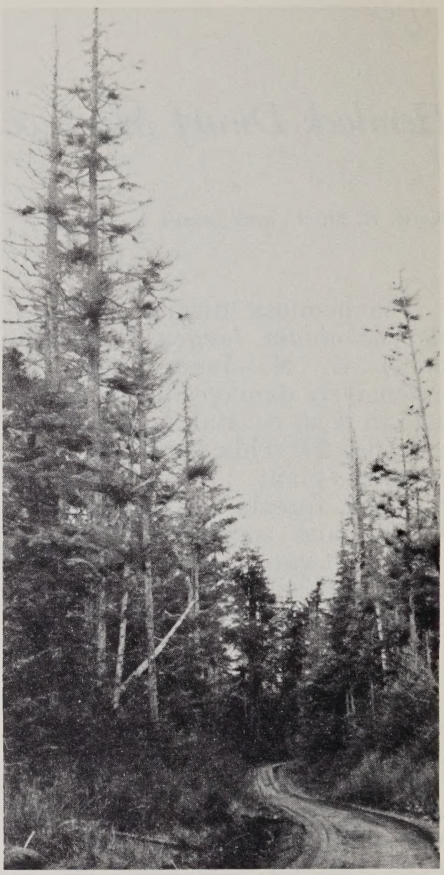

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Figure 3.—Dead, dying, and severely broomed trees reduce timber production and esthetic values in this severely infested hemlock forest.

Life Cycle

Hemlock dwarf mistletoe seeds are dispersed in the fall with peak discharge from late September to early November. The seeds germinate early the following spring. The elongating radicle of the germinating seed grows along the surface of a twig until it meets an obstruction or break in the bark, usually the base of a needle. The tip of the radicle then forms a disclike holdfast from which an infection peg penetrates the bark tissues. A specialized rootlike system, the endophytic system, develops in the bark tissues and later forms secondary structures (sinkers) which become embedded in the wood.

In 1 to 2 years, a small, spindle-shaped swelling develops on the branch at the infection site. After another 1 or 2 years, small yellowish-green buds break through the bark and develop into aerial shoots. Flowering occurs in late summer, from August to early September. Insects are the primary pollinators. The fruit matures in the fall of the following year. Thus, a minimum of 4 to 6 years is ordinarily required to complete the life cycle. In some instances, infections may remain in the host tissues for years before aerial shoots appear. During this time, the small swellings are the only evidence of infection.

The plant is a perennial, and its aerial shoots may produce more than one crop of fruits.

Symptoms and Signs of Infection

The aerial shoots (fig. 1) are the most positive diagnostic characteristic. Hemlock dwarf mistletoe shoots vary from greenish to reddish yellow, averaging from about 2 to 5 inches long. The shoots are sparse and poorly developed in dense stands, older infections, and lower branches. They reach maximum size on open-grown trees or in upper crowns exposed to sunlight.

When aerial shoots are absent, the basal cups (fig. 4) often are present on the spindle-shaped swellings of invaded branches. The basal cups remain for many years after aerial shoots have disappeared.

The most conspicuous evidence of infection are witches'-brooms (fig. 5, left and right) which result from proliferation of branches at the infection site. Witches'-brooms vary from small, palmlike structures in young infections to large masses of branches weighing several hundred pounds in old ones.

When the tree trunk is invaded, abnormal growth occurs, and in time large trunk cankers (fig. 6) may develop. These cankers and branch stubs remaining from broken brooms frequently serve as entry points for decay-causing fungi.

In young trees, witches'-brooms and cankers may be absent or much less conspicuous than in old trees. The spindle-shaped swollen branches accompanied by aerial shoots or basal cups will indicate the presence of dwarf mistletoe.

Spread and Intensification

Dwarf mistletoe on hemlock is spread by seeds produced singly within a fruit. When ripe, the fruit develops water pressure and ruptures at its base, discharging the seeds up to 50 feet, occasionally further. However, most seeds fall within 15 to 20 feet of their source.

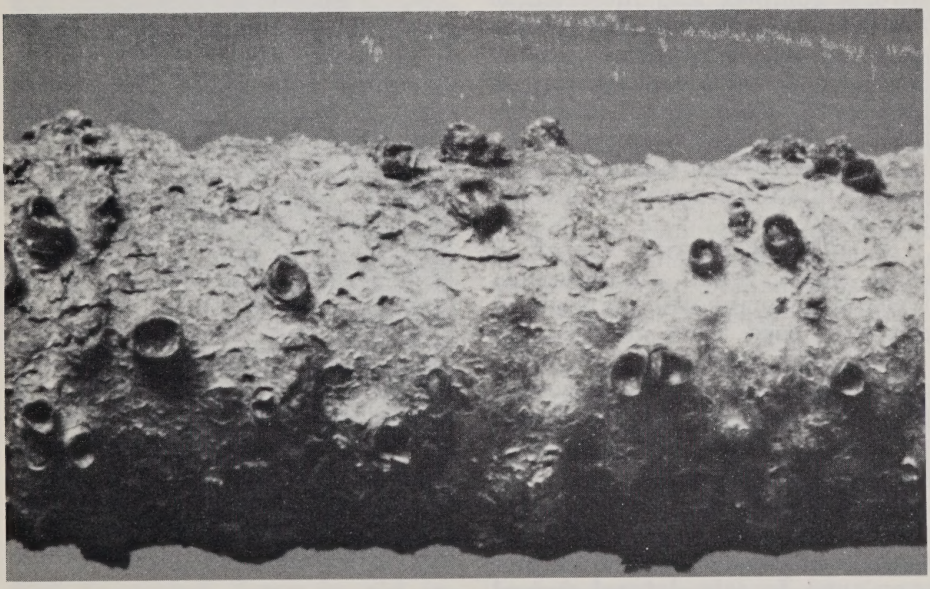

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Figure 4.—Basal cups of *Arceuthobium tsugense* indicate the presence of the parasite.

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Figure 5.—*Left.* Small, palmlike witches-brooms on a young western hemlock. *Right.* Large witches'-broom on the trunk of a western hemlock.

The seeds are coated with a sticky substance (viscin) and will adhere to most surfaces they strike. Those that land on needles and young twigs of susceptible hosts are those that may start new infections.

The rate of spread of the parasite in the forest depends upon several complex and interrelated factors. These include the composition of the tree species, structure of the stand, and spacing of the trees. Each forest has distinctive characteristics which influence the rate at which hemlock dwarf mistletoe spreads and intensifies.

In all-aged forests, spread is most rapid. Small (understory) trees are continuously exposed to mistletoe seed from infected tall (overstory) trees. After overstory trees die or are harvested, they are replaced by the larger understory trees, and the cycle of infection goes on.

In even-age forests, spread of dwarf mistletoe is much slower than in all-aged forests. In dense even-aged forests, lateral spread is probably less than 1½ feet a year because the thick foliage reduces light intensity necessary for prolific seed production, and intercepts the discharged seed. In open-grown, thinned stands, the parasite may spread faster because increased light favors

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Figure 6.—The swelling is a trunk canker resulting from infection by hemlock dwarf mistletoe.

seed production and the seeds are discharged for greater distances.

Practices which promote continuous growth of trees of various ages in a forest perpetuate dwarf mistletoe and increase its damage. Regeneration that develops after complete harvest or stand destruction is seldom infested.

Damage

Hemlock dwarf mistletoe reduces growth of trees and speeds mortality. Infected branches and witches'-brooms disrupt normal tree physiology causing a tremendous drain on the tree vitality and reducing its growth. When a major portion of the live crown is occupied by infections and brooms, the tree is weakened and dies prematurely. Death occurs as a direct result of the infection or from attacks by diseases and insects on the already weakened tree.

Infections also affect quality and usable volume of wood. The presence of the endophytic system in wood alters its physical and chemical properties and reduces its quality. The large knots associated with brooms reduce lumber values. Decay fungi enter through cankers and branch stubs of large brooms; cull (wood rendered unusable) increases.

The combined effects of hemlock dwarf mistletoe on the timber resource result in losses estimated at over 40 million cubic feet annually in Oregon and Washington. Comparable losses occur throughout the rest of the range of the parasite.

The effects of hemlock dwarf mistletoe on other forest values are equally important. In recreational areas, hazardous conditions are created by the large witches'-brooms, which may break and fall. Increased decay in old infected trees greatly reduces structural strength which creates danger from falling trees. In scenic areas, accelerated mortality and numerous dead tops and snags are unsightly (fig. 3). The overall decadence of severely infested stands provides opportunities for catastrophic outbreaks of insects, diseases, and fire.

Control

Hemlock dwarf mistletoe is controlled by cultural practices. No chemical or other methods for control are available.

The most effective method of control in timber-producing forests is eradication by complete harvest of infested stands. This method applies to stands which will be managed for hemlock. When cutting boundaries are laid out, reinvasion of harvested areas can be prevented by taking advantage of barriers such as roads, ridgetops, and changes in timber types. After usable trees are harvested, all remaining infected trees, regardless of size, must be destroyed. It takes only 10 evenly spaced, infected trees remaining per acre to reinfest the entire new stand.

When complete harvest of infested stands is not appropriate, shelterwood or seed tree methods for obtaining regeneration are good alternatives. As many infected overstory trees as possible should be removed at the initial harvest. When regeneration is established but before trees are 3 feet high or 10 years old, whichever is first, all remaining infected overstory trees are cut. Infection in the new stand then should be sufficiently low to cause little loss during the rotation. However, during all subsequent cultural treatments, obviously infected trees should be cut.

Thinning moderately-to-severely infested hemlock stands is not recommended. Identification of dwarf mistletoe-infected trees in

dense, young stands is very difficult because of limited symptom expression. Many infections will be missed, and the spread of the parasite will accelerate, largely offsetting the benefits of thinning. Lightly infested stands may be thinned with rigorous discrimination against trees suspected of being infected and trees obviously infected.

Control in recreational and other high-use areas is sometimes needed to prolong life of the tree. When adequate crown is present, tree vigor can be improved by pruning those branches bearing blooms. During maintenance work in recreational areas, heavily broomed branches should be removed, and trees with large, well-developed cankers felled to reduce hazard.

References

MANAGEMENT OF WESTERN HEMLOCK INFECTED WITH DWARF MISTLETOE. D. C. BUCKLAND AND E. G. MARPLES. Br. Columbia Lumberman 36(5):50, 51, 136, 138, 140, illus. 1952.

ANNUAL LOSSES FROM DISEASE IN PACIFIC NORTHWEST FORESTS. T. W. CHILDS AND K. R. SHEA. Pac. Northwest Forest & Range Exp. Stn. USDA For. Serv. Resour. Bull. PNW-20, 19 p., illus. 1967.

BIOLOGY AND CLASSIFICATION OF THE DWARE MISTLETOES (*Arceuthobium*). F. G. HAWKSWORTH AND D. WIENS. U. S. Dept. Agric., Agric. Handb. No. 401, 234 p., illus. 1972.

DWARF MISTLETOE OF COASTAL WESTERN HEMLOCK: PRINCIPLES AND PRACTICES FOR CONTROL. KEITH R. SHEA. Weyerhaeuser For. Pap. 9, 14 p., illus. 1966.

HEMLOCK AND LARCH DWARF MISTLETOE SEED DISPERSAL. RICHARD B. SMITH. For. Chron. 42:395-401, illus. 1966.

ASSESSING DWARF MISTLETOE ON WESTERN HEMLOCK. R. B. SMITH. For. Sci. 15:227-285, illus. 1969.

DEVELOPMENT OF DWARF MISTLETOE (*Arceuthobium*) INFECTIONS ON WESTERN HEMLOCK, SHORE PINE AND WESTERN LARCH. R. B. SMITH. Can. J. For. Res. 1:35-42. 1971.

SOME EFFECTS OF DWARF MISTLETOE ON WESTERN HEMLOCK. R. W. WELLWOOD. For. Chron. 32:282-296, illus. 1956.

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